New Entozoon from the Ostrich.

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[Plate IV.]

On the 23rd of March 1880 I received from South Africa two bottles, the larger one containing part of the proventriculus of a young Ostrich preserved in spirit, and the smaller one a quantity of loose vegetable débris, in which were several Nematode worms. These were sent by Mr. Arthur Douglass, of Heatherton Towers, near Grahamstown; and, by letter, I was informed that the bird yielding the parasites had not died in consequence of the disease from which it was actually suffering, but had been purposely destroyed on account of a broken leg.

Speaking of the proventriculus as the "paunch corresponding with the crop of other birds," Mr. Douglass says to me in his letter:—"You will find vast numbers of small Entozoa in the mucus. A medical gentleman who examined them believes them to be a totally unknown worm." Mr. Douglass's statement and his friend's inference are correct. The parasite represents a new species; and in my reply to the discoverer, I provisionally named it *Strongylus Douglassii*. Judging from the materials sent, the number of parasites in this bird must have amounted to several thousand.

For diagnosis I give the following characters:—

Strongylus Douglassii, sp. nov.—*Body* smooth, transversely striated, nearly uniform in thickness, rather suddenly narrowed in front; *head* minute, often spirally folded inwards; *mouth* simple, unarmed; *œsophagus* long, gradually thickening below; *tail of the male* with a broad, two-lobed hood and simple ray-arrangement; *spicules* short, stout, closely applied; *tail of the female* directed inwards, suddenly narrowing below the *anus*, which is subterminal.

Length of male $\frac{1}{6}$ inch, breadth about $\frac{1}{240}$ of an inch.
Length of female $\frac{1}{5}$ inch, breadth about $\frac{1}{215}$ of an inch.
Hab. Proventriculus of *Struthio camelus*.

The transparency of the body enables one to ascertain the general structure of this little nematode without dissection. The mouth and intestinal tract offer no marked peculiarity; but in many of the preserved specimens the integuments about the head are so inflated by endosmosis that they are frequently inverted.

From this cause an inexperienced observer might readily mistake the cup-shaped inverted portion for the lining membrane of a large buccal cavity. The oral opening leads to a small œsophageal tube, which for a short distance is strengthened by chitinous thickening. The head itself is something less than $\frac{1}{1000}$ inch in breadth, the extremity of the tail in the female being less than $\frac{1}{1500}$ inch in diameter.

The internal reproductive organs of the male show a simple vas deferens or tubal prolongation from the seminal receptacle; but the short, broad, and uncleft spicules are to some extent characteristic of the species. They present an average length of $\frac{1}{220}$ inch by $\frac{1}{770}$ inch in breadth.

The accessory appendages are especially noteworthy. In general configuration and ray-distribution, the hood approaches the pattern found in *Strongylus ventricosus*; but this latter strongyle is very much larger. In breadth the hood of *Strongylus Douglassii* measures $\frac{1}{115}$ inch, whilst its vertical diameter is about $\frac{1}{220}$ inch. In this species the anterior ray is split into two widely diverging branches, the lower being paramount. A similar peculiarity is found in the anterior ray of *S. ventricosus* of the ox and deer, in *S. nodularis* of ducks and geese, and in *S. retortæformis* of the hare; at least Schneider has so represented the character of the anterior ray in these species. In *S. Douglassii* both the ray-divisions are papillated at their points; but I did not notice papillary terminations in any of the succeeding rays. The thumb-and-finger-like appearance of these upper ray-divisions is very striking. The antero-lateral ray is comparatively large. The middle ray is divided to the base, its portions being nearly equal. The postero-lateral ray is narrow, and does not extend to the border of the hood. The posterior ray is united to its fellow of the opposite side; it is long and narrow, bifurcated at the lower third, the inner branch being also forked. All the divisions of the posterior ray extend to the circumferential margin of the hood, which at this (the lowermost) point slightly projects, as if forming a rudimentary third lobe. The hood-membrane itself displays the usual radiating striæ, bespeaking its integumentary origin; and above it the ventral surface of the body is marked by several undulating lines or ridges directed obliquely outwards.

The internal reproductive organs of the female worm, while conforming to the nematode type generally, show the uterine and ovarian portions very distinctly. The vulva is situated $\frac{1}{15}$ inch

above the point of the tail. The narrow cæcal end of the upper ovary passes into the superior third of the body, and usually folds upon itself once or twice. The lower uterine horn, after passing downwards to very near the anus, suddenly bends upward, and terminates in a narrow ovarian cæcum, which occupies a position corresponding with that of the tubal portion of the superior uterine horn. The most striking feature, however, is that which relates to the small number and comparatively large size of the eggs. Roughly, their separate measurement averages $\frac{1}{480}$ inch in length by $\frac{1}{750}$ inch in breadth. The more perfect eggs contain incompletely formed embryos. As hitherto we have been accustomed to find the Strongyles supporting a very large number of ova, this paucity of eggs is, so far as my experience goes, altogether peculiar. Amongst the free Nematodes one constantly encounters females with only one, two, or several perfect ova; but I know of no Strongyle carrying so few as twenty to thirty eggs; yet that peculiarity obtains in this Strongyle from the Ostrich. When, recently, Dr. Örley, the Hungarian helminthologist, visited this country, I had an opportunity of showing him *S. Douglassii* under the microscope. He at once recognized the exceptional character of this phenomenon.

Practical Considerations.—Some useful and interesting particulars are related in the communication received from Mr. Douglass. The victimized bird was 18 months old, being one of a flock. On opening it, the worms, he says, "were all alive, although the flock had had salt with their food daily for a month, and a week before one ounce of sulphur each." My informant's surprise was not unnatural, seeing that agriculturists have long appreciated the value of salt and sulphur as a prophylactic and parasiticide. Many years ago Professor Simonds conducted a simple experiment, which showed that salines proved fatal to a worm infesting the stomach of a lamb. He called the parasite *Filaria hamata*; but I subsequently identified it with *Strongylus contortus* of Rudolphi. Mr. Douglass says that he first discovered these Ostrich-Entozoa in December 1879, "when a flock of 200 Ostriches, running in a camp of 4000 acres, suddenly fell off in condition, and three died." He examined the dead birds, and adds:—"I found the mucus of about half the paunch to have acquired a fungus growth of an inch or more in length, under which the paunch was red with millions of these worms. Shortly after, three more of the flock were worried to death by dogs, and they were all affected [by the parasite]. From the appearance of the others, I knew the whole to be so; and from reports of the mortality in birds from all parts of South Africa, I believe the disease to be general."

From experiences long ago gathered by myself in the investigation of Grouse and Pigeon epidemics, respectively, and from what I have also discovered to obtain in the case of certain animal epidemics not hitherto judged to be of parasitic origin, I was in no way surprised at this announcement of a new avian epizoöty due to parasitism. All the helminthic outbreaks present certain features in common. As fatal epidemics or plagues they come and go; and although the parasites that cause them are never really altogether absent, the evil results of invasion are only manifested and recorded when the parasites are sufficiently numerous to make their presence felt—that is, epidemiologically speaking. All epizootics of this character are immediately due to excessive multiplication of worms, the unusual prevalence being itself due to exceptionally favourable conditions.

When the Grouse-disease prevailed, alarmists predicted that these valuable game-birds would soon share the fate of the Dodo; yet, as I pointed out at the time, this conclusion was based upon an entire misunderstanding as to the nature of the disorder. If it could not be shown that the Grouse epidemics of former years were due to parasitism, I at least demonstrated that the outbreak of 1872–73 was principally caused by a Nematode not then known to science. This worm I named *Strongylus pergracilis* *. Upwards of thirty Grouse were examined by me during the epidemic, most of the diseased birds having been either captured alive or shot on the Earl of Cawdor's moors. The Grouse and Ostrich Strongyles bear a considerable resemblance to one another; but the Grouse worms are much longer and otherwise differ. Not improbably the mode of development is similar, both requiring a change of hosts. Be that as it may, and in absence of special researches upon this point, I may observe that the method of dealing with the Ostrich epidemic was in the right direction. Had the salines been combined with lime-water, I think the treatment would have proved more or less effective. What is really wanted is some drug that is known to exert a special action on Nematode worms without injuriously affecting the host. It seems to me that the so-called milk of Papaw (*Carica papaya*) is likely to answer the purpose. The remarkable properties of the active principle of this drug (as made known by M. Wurtz, and referred to at a former Meeting of this Society) would at once suggest the use of Papaw in any form of nematelminthiasis; and the practical efficiency of the drug as an oxyurifuge has been attested by Dr. Peckolt †. Several years ago Dr. Marcet showed that the perivisceral fluid of the larger Nematodes closely corresponded with the ordinary juice of flesh; and without doubt this fluid is mainly concerned in sustaining the life of the worms ‡. Since, therefore, Papaine possesses the power of

* 'The Grouse Disease; a statement of facts tending to prove the parasitic origin of the epidemic.' 'The Field' Office, London, 1873.

† Pharmaceutical Journal, vol. x. See also Mr. Christy's 'New Commercial Plants and Drugs,' No. iv. p. 38: London, 1881.

‡ Proceedings of the Royal Society, vol. xiv. p. 69 (1861).

dissolving fibrine, it is likely that its absorption by endosmose when brought into contact with the worms would destroy them. It is not probable that any difference of action would result by employing the drug for the destruction alike of Strongyles, Ascarides, Oxyurides, or even Filariæ. I would strongly advise the Ostrich-farmers to give Pawpaw a fair trial. To some it will naturally occur to recommend santonine; but seeing how injuriously this agent has acted upon puppies, and also how ineffective for good it has proved in our hands in cases of Oxyurides, its employment in young Ostriches seems contra-indicated.

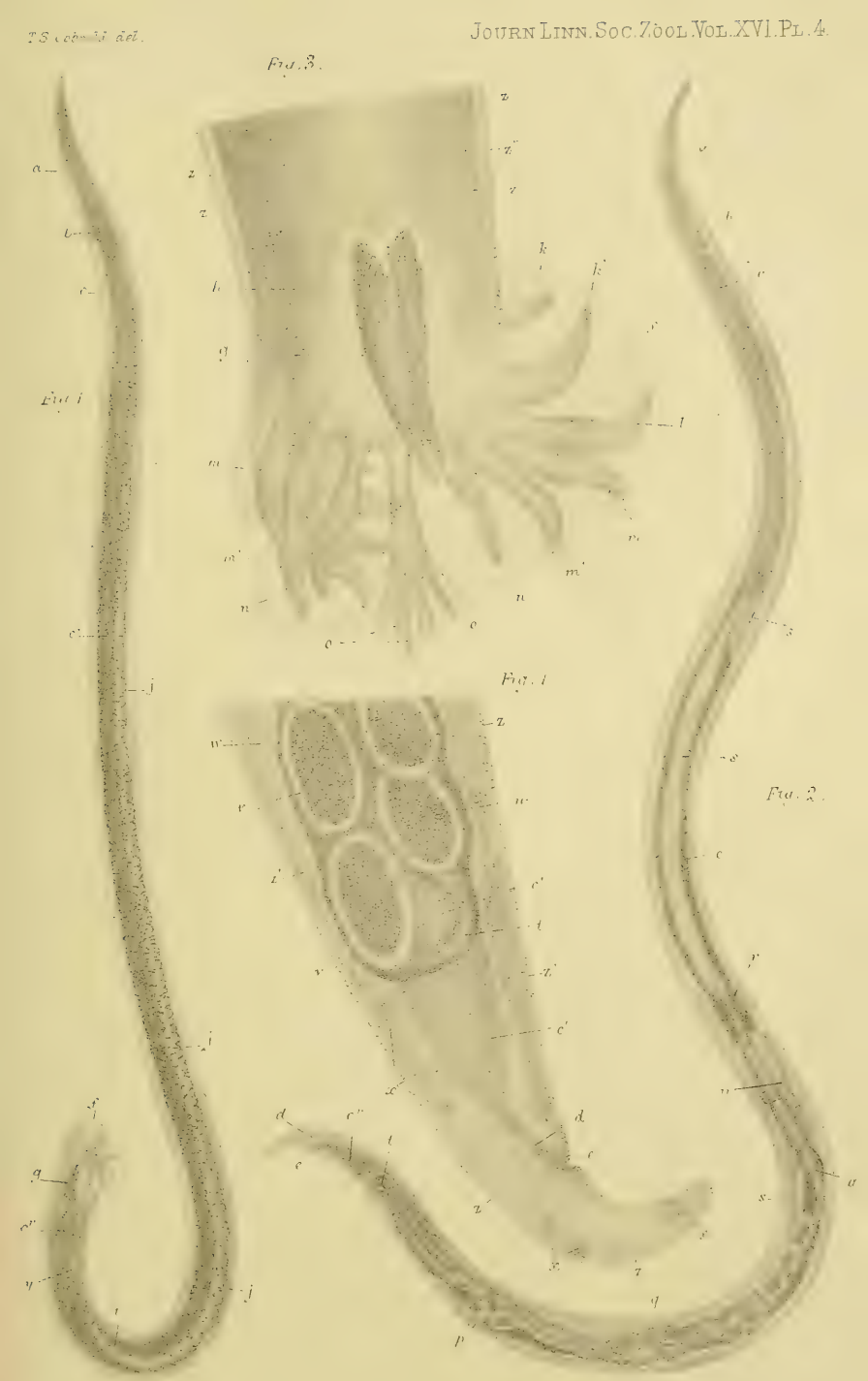
But there is another practical phase of this question of great interest. It appears to me that these epidemics form, as it were, by-way phenomena of the "struggle for existence." In this view they are most instructive. This Ostrich epizoöty is a kind of *strongylosis*; and as such it has its counterpart in the *trichinosis* of swine, in the *olulanosis* of cats, in the *filariasis* of man, and so forth—all these disorders representing so many special forms of *helminthiasis*. In every case we see a multitude of liliputian creatures battling for their own existence. The war is carried on at the expense of the victims infested; and when, as in the instance before us, the parasites become abnormally prodigious in number, then the bearer or victim is injured. In other words, the invaded territory suffers from overcrowding and multiplied wounds. Of course, amongst avian, as also among mammalian victims, the smaller and younger hosts suffer more readily than adults. Thus lambs perish more quickly than sheep, colts than horses, chicks than their parent birds. In extreme cases no animal, whatever its size or age, can long withstand the assaults of certain kinds of internal parasites, armed as they not unfrequently are with boring weapons. Thus also, as has been recently shown in my paper on the parasites of Elephants, comparatively small Entozoa are often as effective for mischief as the larger species.

DESCRIPTION OF PLATE IV.

Figs. 1 & 2. Male and female *Strongylus Douglassii*. × 65 diameters.

3 & 4. Caudal extremities of the same. × 260 diam.

a, head; *b*, œsophagus; *c*, chylous intestine, *c'*, middle, and *c''*, lower ends of the same; *d*, rectum; *e*, anus; *f*, hood and rays of the male; *g*, spicules; *h*, sheath; *i*, vas deferens; *j*, testis; *k*, *k'*, anterior ray-divisions; *l*, antero-lateral ray; *m*, *m'*, middle ray-divisions; *n*, posterior lateral ray; *o*, posterior ray of the right lobe; *o'*, branches of the posterior ray of the left lobe; *p*, vulva of the female; *q*, upper uterine horn; *r*, tuba; *s*, ovarium, and *s'*, upper ovarian cæcum; *t*, fold of lower uterine horn; *u*, cæcal end of the lower ovarium; *v*, ovum; *w*, embryo; *x*, caudal papillæ of the female; *y*, oblique skin-folds of the male; *z*, transverse cutaneous striæ; *z'*, longitudinal muscle-cells; *z''*, retractor muscle of the sheath of the male spicule.



STRONGYLUS DOUGLASSII. *Cobb.*